High Risk But Not Always Lethal: The Effect of Cirrhosis on Thermally Injured Adults

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The aim of this article was to determine the effect of cirrhosis on mortality in thermally injured adult patients. We conducted a retrospective review of patients admitted to our burn center during 2003 to 2010. Eight hundred eight patients were included in this study, of whom 24 had the diagnosis of cirrhosis established from electronic medical records and/or autopsy reports. The mortality rate for the cirrhotic patients was 50%, and for the noncirrhotic patients it was 14.8%. On logistic regression, age (odds ratio [OR], 1.08; confidence interval [CI], 1.06–1.10), TBSA (OR, 1.08; CI, 1.06–1.10), inhalation injury (OR, 3.17, CI, 1.61–6.25), and cirrhosis (OR, 8.78; CI, 2.97–25.98) had independent effects on mortality. Of the 24 cirrhotic patients in this study, the admission Model for End-Stage Liver Disease score for the patients who survived hospitalization was 12.1±4.0, and for the patients who died it was 13.8±6.0 ($P = .4$). When comparing patients with 10 to 50% TBSA burn, the mortality rate for cirrhotic patients was 83.3% (10/12), and for the noncirrhotic patients it was only 12.7% (50/394), $P < .0001$. Adults with cirrhosis are rarely able to survive burn injuries > 10% TBSA. Although we did not detect a significant association between admission Model for End-Stage Liver Disease score and death, the presence of cirrhosis is a high premorbid contributor and, therefore, new strategies are needed to improve outcomes. (J Burn Care Res 2013;34:115–119)

Cirrhosis is the final common pathway on the spectrum of many types of chronic liver injury.[1] In the United States, the two most common causes of cirrhosis are chronic hepatitis C virus infection and chronic alcohol ingestion.[2] The cardinal and irreversible pathologic features of cirrhosis are bridging fibrous septa, the formation of regenerative parenchymal nodules, and disruption to the entire hepatic architecture.[3] This extensive liver fibrosis is caused by the activation of the hepatic stellate cell, and this loss of hepatocellular function can lead to jaundice, edema, coagulopathy, and various metabolic abnormalities.[1]

Little has been reported on the contribution of cirrhosis as a premorbid condition on outcomes in burn patients,[4,5] and current thoughts are extrapolated from retrospective general surgery and trauma literature. Mortality rates for patients undergoing nonemergency nonhepatic abdominal surgeries with Child-Turcotte-Pugh class A, B, and C are in the range of 9 to 15%, 29 to 40%, and 65 to 70%, respectively.[6,7] However, the use of the Child-Turcotte-Pugh score in the prognosis of cirrhotic patients is subjective and can be subject to interphysician variability. Recent studies in the trauma population support that cirrhosis is an independent risk factor for increased mortality and higher complication rates after trauma, and that injured cirrhotic patients who undergo laparotomy are significantly more likely to die than injured noncirrhotic patients.[8] While the Model for End-stage Liver Disease (MELD) score appears to permit risk stratification for cirrhotic patients who have sustained traumatic injuries,[9] the same has not been done for burn patients.

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Burn patients are already at high risk for morbidity and mortality. We observed that our thermally injured patients with known cirrhosis appeared to have a high rate of death when compared with similar noncirrhotic patients. The purpose of our study, therefore, was 2-fold: to determine the effect of preexisting cirrhosis on mortality in thermally injured patients, and to verify criteria that could help to predict the clinical outcome of these patients.

Methods

Under a protocol approved by our institutional review board, we conducted a retrospective review of all patients admitted to our burn center during the period 2003 to 2010. Patients were excluded if they were admitted or transferred after 72 hours, if they were injured on the battlefield in Iraq or Afghanistan, if they had confounding mechanical trauma, if they had chemical or electrical injuries, if they had soft-tissue infection, or if they had exfoliating skin disorders. The diagnosis of cirrhosis was established from electronic hospital medical records and/or autopsy reports for 24 patients. Statistical Analysis Software v 9.2 (SAS Institute Inc., Cary, NC) was used to perform logistic regression on mortality with age, TBSA burned, full-thickness (FT) burn size, inhalation injury, and cirrhosis as the candidate predictors for the 24 cirrhotic patients compared with the 784 noncirrhotic patients. Additionally, two databases of the 24 cirrhotic patients were compiled. One database analyzed the 12 cirrhotic patients who lived vs the 12 cirrhotic patients who died, and the other database analyzed the 10 cirrhotic patients with <10% TBSA burn vs the 14 cirrhotic patients with ≥10% TBSA. The MELD scores were calculated using the formula as modified by the United Network for Organ Sharing: 3.78[Ln serum bilirubin (mg/dL)] + 11.2[Ln INR] + 9.57[Ln serum creatinine (mg/dL)] + 6.43.[9] Data are presented as means ± SDs. Continuous variables were compared using the Kruskal-Wallis test, and categorical variables were compared using the χ^2 test. Statistical significance was accepted at $P < .05$.

Results

Eight hundred eight patients met the inclusion criteria for this study, of whom 24 had cirrhosis (C) and 784 noncirrhosis (NC). The mortality rate for the cirrhotic patients was 50% and 14.8% for the noncirrhotic patients. C and NC were not significantly different on TBSA (C, 17.1±17.0%; NC, 22.6±22.2%; $P = .23$). FT burns were significantly higher for noncirrhotics (C, 8.0±16.1%; NC, 12.7±19.4%; $P = .004$). They also differed in age (C, 58.3±13.6 yr; NC, 41.7±18.7 yr; $P < .0001$) and incidence of inhalation injury (C, 29.2%; NC, 13.7%; $P = .03$). On logistic regression, age (OR, 1.08; confidence interval (CI), 1.06–1.10), TBSA (OR, 1.08; CI, 1.06–1.10), inhalation injury (OR, 3.17; CI, 1.61–6.25), and cirrhosis (OR, 8.78; CI, 2.97–25.98) all had an independent effect on mortality (Figure 1).

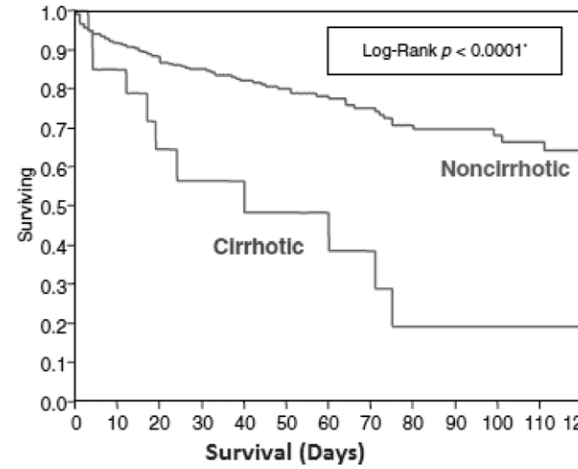

Figure 1. Product-limit survival fit.

None of the 10 cirrhotic patients with <10% TBSA burns died, and only three of the 285 (1.1%) noncirrhotic patients with <10% TBSA burns died. When comparing our patients with 10 to 50% TBSA burn, the mortality rate for the cirrhotic and noncirrhotic patients was 83.3% and 12.7% ($P < .0001$). The two cirrhotic patients in the burn category of >50% TBSA died, and 63 of the 105 noncirrhotics with a TBSA thermal injury > 50% died. (Figure 2).

Of the 24 cirrhotic patients in this study, 12 survived (S) hospitalization and 12 died (D). These two patient groups were similar in age (S, 56.0±11.2 yr; D, 60.6±15.8 yr; $P = .4$), FT (S, 1.9±2.7%; D, 14.7±21.0%; $P = .0596$), length of stay (S, 19.6±31.9; D, 25.5±26.4; $P = .6$), and admitting MELD score (S, 12.1±4.0; D, 13.8±6.0; $P = .4$), but differed in TBSA (S, 8.0±12.0%; D, 26.4±16.4%; $P = .0049$), inhalation injury (S, 0%; D, 50%; $P = .0047$), and admitting injury severity score (S, 4.9±6.7; D, 15.9±9.3; $P = .0031$).

Three of the survivors had excision and grafting of their burn wounds, and two other patients underwent nonexcision procedures (ie, Versajet debridement, esophagogastroduodenoscopy with banding of bleeding varices). Eight of the 12 nonsurvivors

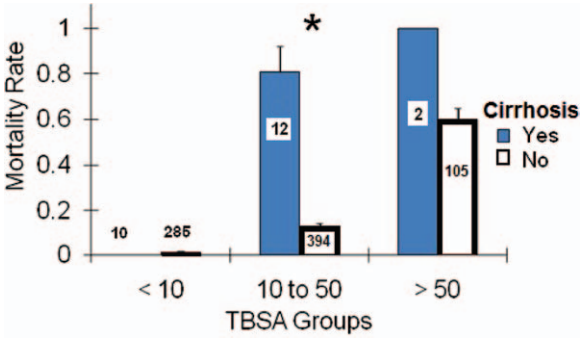

Figure 2. Mortality rate of cirrhotics compared to noncirrhotics in groups based on % TBSA.

underwent excision and grafting, and 50% (6/12) underwent nonexcision surgical procedures (eg, laparotomy, fasciotomy, tracheostomy, and so on).

For the three cirrhotic patients who survived and who also received a blood product transfusion, the mean number of units of packed red blood cells (PRBCs) was 17.5 (although one of those patients received 35 PRBCs), the mean number of units of fresh frozen plasma was 3.0, and the mean number of units of platelets was 1.0. Of the 11 cirrhotic patients who died and who also received a blood product transfusion, the mean number of PRBCs was 26.3, the mean number of units of fresh frozen plasma was 5.9, and the mean number of units of platelets was 3.2. Differences between survivors and nonsurvivors were nonsignificant.

For the cirrhotic patients who died, 67% (8/12) had confirmed sepsis at the time of death, and 33% (4/12) had documented coagulopathy. All but two cirrhotic patients who died demonstrated multiorgan dysfunction syndrome at their time of death. Of the other two, one died of severe postoperative coagulopathy on hospital day 4; the other developed coagulopathy in the postoperative period and, despite massive transfusion, could not be resuscitated.

Separating the cirrhotic patients into <10% or ≥10% TBSA burn categories showed the following: 10 patients sustained a <10% TBSA burn (minor injury, or M), and 14 patients sustained a ≥10% TBSA burn (large injury, or L). These two patient groups were similar in age (M, 56.9±11.9 yr; L, 59.2±15.1 yr; P = .8145), and admitting MELD score (M, 12.2±4.2; L, 13.8±6.0; P = .8040) but differed on FT (M, 1.6±2.5%; L, 13.1±19.8%; P = .0303), inhalation injury (M, 0%; L, 43%; P = .0168), length of stay (M, 7.0±5.7; L, 33.4±33.8; P = .0190), and admitting injury severity score (M, 2.5±1.6; L, 16.6±9.1; P = .0001).

Discussion

The principal findings of this study are that: 1) adults with cirrhosis are rarely able to mount the physiologic response needed to survive burn injuries >10% TBSA; 2) we did not detect a significant association between admission MELD score and death, albeit in a small sample size; and 3) the presence of cirrhosis is a high premorbid contributor of death in burn patients and therefore new strategies are needed to improve outcomes.

The morbidity of chronic liver disease and cirrhosis accounts for a large financial burden to our economy and was the 12th leading cause of mortality in the United States in 2007 (with a 3.4% increase compared with 2006).[10] Patients with a history of chronic liver failure have been known to have dysfunction of multiple organ systems and an overall decreased life expectancy. Patients with cirrhosis undergoing elective or emergent operations are at an increased risk of developing postoperative complications leading to death.[8,11,12] Georgiou et al[13] have also demonstrated that trauma and liver failure portend a worse prognosis whether the injuries sustained require operative or nonoperative management.

We examined the number of operations in the cirrhotic group. It is difficult to compare the number of excision and grafting procedures required by the cirrhotic patients who died vs the cirrhotic patients who lived for reasons of small numbers in the survival group, but we feel that cirrhosis should not be considered an absolute contraindication to burn surgery.

The Child-Turcotte-Pugh classification was originally designed to assess the operative risk in patients undergoing surgical portosystemic shunt placement, although this system has also been used to stratify patients on the waiting list for liver transplantation.[14] However, the use of MELD is a reliable measure of mortality risk in patients with end-stage liver disease and is suitable for use as a disease severity index to determine organ allocation priorities.[15] It has also been shown to be a better predictor of in-hospital mortality in a cohort of patients with alcoholic hepatitis or cirrhosis than the Child-Turcotte-Pugh classification system.[16–18] In addition, studies have demonstrated that MELD scores perform as well as or better than the modified Maddrey discriminant function in predicting mortality at 30 days for patients with alcoholic hepatitis (based on laboratory values obtained within 24 hours of admission),[19,20] although we could not calculate discriminant function scores for our patients because of laboratory limitations. We do not know of a study that has examined the use of MELD scores or the diagnosis of cirrhosis in burn patients, and only

two previous reports suggested that patients with a diagnosis of liver disease sustaining thermal injury are at greater risk for mortality, regardless of age or TBSA burn.[4,5] The mean MELD scores for our survivors vs nonsurvivors were not significantly different, and both are considered low.[7,16,21] We recognize that with a larger sample of cirrhotic patients, a significant difference between the MELD scores of survivors and nonsurvivors might have been exposed.

In our study, when comparing 808 thermally injured adult patients with and without liver disease, logistic regression analysis demonstrates that the independent predictors of mortality are age, TBSA, inhalation injury, and cirrhosis. Among patients with any size burns, cirrhosis increases the odds of death by almost 9-fold. When comparing only the cirrhotic patients with a burn size of ≥ 10% TBSA, mortality rates increase from 0 to 86%. The comparison of the 406 patients in this study with a burn size of 10 to 50% TBSA, a cohort where modern burn surgery and critical care experience have been observed to have a large impact on survival, shows that cirrhosis independently increases mortality from 12.7 to 83.3%.

In this study, 33% (4/12) of the cirrhotic patients who died had a documented coagulopathy at the time of death, and 92% (11/12) received some blood product transfusion during their hospitalization. The number of blood products transfused for the cirrhotic patients who died was greater than that for those who lived, although this was nonsignificant. In addition, almost half of the nonsurvivors who required blood component therapy during their hospitalization received their transfusions outside of the perioperative period.

The limitations of this article are those of other retrospective studies. We wanted to assess other comorbid conditions that might, in addition to cirrhosis, alter a patient's risk of mortality. Unfortunately, because of the limited detail present in patients' medical histories, the accurate use of a Charlson comorbid index was not possible.[22] In addition, 4 of the 12 cirrhotic patients identified in this study who died during hospitalization were diagnosed by autopsy alone. At this institution, 75% of our patients who die undergo autopsies. Thus, it can be presumed that some patients who died, but did not undergo autopsies, were incorrectly classified as noncirrhotic patients in this study.[23]

Conclusion

Patients with a history of cirrhosis and liver dysfunction have a shorter life expectancy and fare worse after sustaining traumatic injuries than patients without cirrhosis.[9,13] Unlike the results cited in the trauma literature, we were not able to detect a significant association between admitting MELD score and death in our limited population. However, the diagnosis of cirrhosis, preceding the physiologic insult of thermal injury, independently increased the odds of death by almost 9-fold. In those with a combination of significant burns (≥10% TBSA) and cirrhosis, mortality approaches 90%. Cirrhosis in thermally injured patients is not uniformly fatal, but new treatment strategies are needed to improve outcomes.

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